

REMARKS

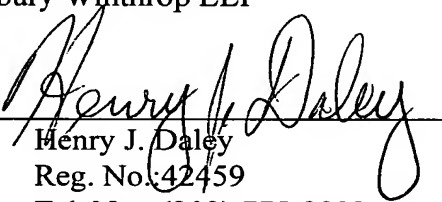
By this Amendment, the specification has been amended to include a cross-reference to the parent application and to include any amendments to the specification of the parent application. Claim 1 is pending.

Prompt consideration and allowance of the present application based on the foregoing amendments and the following remarks are respectfully requested.

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attached Appendix is captioned “Version with markings to show changes made”.

Respectfully submitted,
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APPENDIX

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION:

The specification is changed as follows:

Page 1, line 1, please insert the following new paragraph

--CROSS REFERENCE TO RELATED APPLICATIONS

This application is a divisional application of U.S. Application No. 09/661,474, filed September 13, 2000 which is a divisional of U.S. Application No. 08/805,477, filed February 25, 1997 the specification and drawings of which are incorporated herein by reference.--

Page 11, starting with line 20, change the following paragraph as follows

Next, a description will be given of examples of the condensing optical systems, each of which is mounted in the light source section 11 provided with these light emitting elements. Fig. 3A shows the condensing optical system of the light source section 11 which uses a prism assembly in which two right-angled prisms are cemented and shaped into a cubic form. A band-pass coat is applied to the interface where two prisms 20a and 20b are cemented. The spectral characteristics of a coating film 15 of this, as shown in Fig. 3B, are such that the blue light is transmitted and the red and green light are reflected. A blue light emitting element B is disposed opposite to a surface α of the prism 20a, and a red light emitting element R and a green light emitting element G are placed opposite to a surface β of the prism 20b. Light [form] from the blue light emitting element B is incident on the surface α of the prism 20a, and after being transmitted through the coating film 15, emerges from a surface τ of the prism 20b. On the other hand, light from the red light emitting element R and the green light emitting element G is incident on the surface β of the prism 20b, and after being reflected by the coating film 15, emerges from the surface τ of the prism 20b. At this time, light of three colors of blue, red, and green is compounded by the prism 20b into white light when leaving the prism 20b.

Page 16, starting with line 21, change the following paragraph as follows

Fig. 9 illustrates an example where the light source optical system including the DOE 24 is placed at the distal end of the endoscope. Since the distal end of the endoscope is already equipped with an illuminating optical system, followed by an objective optical system, an electronic pickup section, and forceps, in a tiny space, the placement of the light source optical system, in addition to these, causes oversizing in diameter of the distal end of the endoscope. Thus, in the first embodiment, the DOE 24 with the diffraction face configured on the extremely thin glass base plate is disposed, immediately before an illuminating optical system 27, as the light source optical system, which is made to coexist together in a space originally occupied by the illuminating optical system. This makes it possible to place the light source at the distal end of the endoscope with a conventional tiny diameter. In this case, the red, green, and blue light emitting elements R, G, and B emitting the red, green, and blue light are arranged in such a way that their positions are shifted with respect to one another in the direction of the optical axis of the illuminating optical system 27 and the light source optical system. Such an arrangement is very effective for making free use of a highly limited, tiny space. In order to correct for chromatic aberration produced by the DOE 24, the arrangement is such that the angle of inclination of the light emitting element with the DOE 24 increases with increasing wavelength of the light emitting element. Specifically, an angle of inclination $\theta 1$ of the red light emitting element R is made larger than an angle of inclination $\theta 2$ of the green light emitting element G.

Page 18, starting with line 8, change the following paragraph as follows

For the light source section 11, a light emitting element emitting white light or a small-sized lamp may be used, and in this case, by adjusting the amount of emission light of the light source, a desired amount of light can be derived. Since, however, a xenon lamp, for example, has emission spectra over a wide wavelength region containing infrared and ultraviolet radiation in addition to light (visible) used for observations, unwanted light for observations is produced, and power consumption is increased accordingly, which is of no use. As such, in view of the working efficiency of the power, it is desirable to use [the] a light source with narrow emission spectrum width which produces only rays required.

Page 19, starting with line 23, change the following paragraph as follows

With this system, since the light guide cable becomes unnecessary and light emitted from the light source section 31 reaches the endoscope body 1 without loss of the amount of light, the illuminance of illumination light of the endoscope can be completely prevented from [reducing] being reduced. In the conventional system in which a relatively long light guide cable has been used, if a load, such as extreme bending, is applied to the light guide cable, internal fibers will be broken off and light ceases to be transmitted. In this way, when the conventional system is used for a long period of time, it is imperative that the amount of transmitted light [is] be reduced, but according to the system of the second embodiment, such a problem is not produced.

Page 20, starting with line 22, change the following paragraph as follows

In the system of the third embodiment constructed as mentioned above, the power supply 30 which is relatively [great in volume] large and heavy [in weight] is incorporated in the TV processor 6, and hence the attachment TV camera 10 is characteristic of a lightweight and compact design.

Page 29, starting with line 13, change the following paragraph as follows

The light transmitters shown in Fig. 16D are an example where [the] an amount of light that is enough for observations can be secured, even when each of the light transmitting parts M and N is constructed with the LG bundle. The LG bundle constituting the light transmitting part M is adapted to transmit the light from the light source as copiously as possible to the arbitrary point P, and hence the fiber elements are bundled to be as thick as possible. The LG bundle constituting the light transmitting part N, on the other hand, is such that in response to the request for a reduction in diameter of the distal end of the endoscope, the fiber elements are configured to decrease in number and lengthen as compared with those of the LG bundle of the light transmitting part M (hereinafter, the LG bundles constituting the light transmitting parts M and N are simply referred to as an LG bundle a1 and an LG bundle b1, respectively). Thus, the relation between an area $\Phi 3$ of the exit end of the LG bundle a1 and an area $\Phi 4$ of the entrance end of the LG bundle b1 becomes

$$\Phi 3 > \Phi 4 \quad (3)$$

and when the light transmitted by the LG bundle a1 is rendered incident on the LG bundle b1, a great loss of the amount of light is caused. Provision for this is made by placing a condensing optical system 45 between the LG bundles a1 and b1 so that the light transmitted by the LG bundle a1 is effectively incident on the LG bundle b1. The light collected by the condensing optical system 45 enters the entrance end of the LG bundle b1, holding a large angle of incidence.

Page 37, starting with line 24, change the following paragraph as follows

This embodiment, as illustrated in Fig. 21A, is equipped with the illumination system for endoscopes in which the light guide cable 47 can be separated from a rigid endoscope body "1" provided with a lengthened and non-flexible insertion part 1", and when observations are made, the light guide cable 47 is connected with the connection 48 of the rigid endoscope body 1" and the light from the light source is transmitted to the rigid endoscope body 1" for illumination. For the conventional system of this type, there is, for example, a cystoscope which is inserted in a fine urethra to observe and treat the prostate gland and the urinary bladder. The cystoscope has the lengthened and non-flexible insertion part 1" for making an insertion in the fine urethra, and is considered so that the entire system is constructed from very lightweight and compact design, including a rigid portion subsequent to the insertion part 1", to thereby improve an observer's operability and reduce a patient's load as far as possible. The interior of the urinary bladder spreads into a spherical shape, which seems as if the insertion part 1" of the endoscope would be inserted in the air hole of a rubber ball to observe the inside of the ball. Thus, in order to copiously illuminate the observation field including its periphery, a sufficient amount of light becomes a necessity. In the conventional illumination system for endoscopes of this type, however, since the light transmitting section is separated into the endoscope body and the light guide cable and uses the LG bundle in which the fiber elements are in the range of 0.02 to 0.05 mm diameter, such as that described in the fifth embodiment, the efficiency for transmitting the light from the light source to the distal end of the endoscope is impaired, and a sufficient amount of light for observations is not derived. To meet this problem, the number of fiber elements is increased which constitute the LG bundle situated on the side of the light guide cable which can be shaped into a relatively thick and long form, and the [numeral] numerical aperture of the fiber elements constituting the LG bundle on the endoscope body side is set to be larger than that

of the fiber elements on the light guide side. By doing so, the transmission efficiency of light of the light transmitting section is raised, and a sufficient amount of light for observations can be ensured. In this case, however, that the light guide cable is shaped into the thick and long form causes the observer's operability to be considerably deteriorated, which is unfavorable for the endoscope system such as the cystoscope requiring the lightweight and compact design. The seventh embodiment thus provides the observation system for endoscopes in which the above problem can be solved to richly illuminate the observation field, and the lightweight and compact design is achieved.

Page 39, starting with line 16, change the following paragraph as follows

The light transmitting part, shown in Fig. 21B, on the side of the light guide cable uses [the] a single fiber instead of the conventional LG bundle. By doing so, the transmission efficiency of light is much improved, and at the same time, reductions in diameter and weight of the light guide cable itself are [intended] realized. Thus, as already explained in other embodiments, the incidence efficiency of light at the entrance end and the efficiency for transmitting light to the exit end are enhanced by constructing the light transmitter with the single fiber, so that the amount of light secured by the conventional the light guide cable, as the result that the number of fiber elements of the LG bundle is increased to enlarge the diameter, is obtained with the diameter reduced.

Page 43, starting with line 15, change the following paragraph as follows

Since the light guide cable 47 conducts the light from the light source 61 to the connection 62 located close to the operating table, the entire length of at least 10 m becomes a necessity. The light guide cable 47 and the connection 62 must be placed so that the behavior of the surgeon who performs the operation is not obstructed, and hence, for example, a flexible arm of suspension type is provided in a space above the operating table so that the connection is mounted at the top of the arm and the light guide cable 47 is incorporated inside the arm. It is thus necessary for the light guide cable 47 to have some degree of flexibility.

Page 43, starting with line 25, change the following paragraph as follows

In order that, as mentioned above, requirements for the light guide cable 47 [are] to be fulfilled and a great deal of light can be transmitted from the light source 61 to the connection 62, the eighth embodiment employs the following two kinds of light transmitters. One of them is such that the LG bundle is used which has a core diameter of at least 0.1 mm and a transmission loss characteristic of up to 50 dB/km with respect to the fiber elements such as those shown in the fifth embodiment, and thereby a large amount of light is brought to the connection 62 located at a distance of 10 m from the light source 61 and the light guide cable 47 can be designed to have flexibility.

Page 45, starting with line 22, change the following paragraph as follows

The light emerging from the light guide cable 47, after being totally reflected by the total reflection mirror 71, is broken, by the path splitting mirror 72, into optical paths 0₁ and 0₂, which are introduced to the entrance ends of the plurality of (two) light guide cables 63 by the condensing optical systems 74 and 75, respectively. The path splitting mirror 72, as shown in Fig. 23B, is such that at least three regions composed of a total reflection mirror 72a, a semi-transmission mirror 72b, and a total transmission window 72c are selectively constructed. The path splitting mirror 72, for example, has the mechanism that where one of the plurality of light guide [cable] cables 63 is connected only to the optical path 0₁, the total reflection mirror 72a is selected automatically. In addition, where the plurality of light guide cables 63 are not entirely connected to the connecting optical system 70, provision is made for closing a shutter located on the side of the light source optical system to shut off the supply of light to the light guide cable 47.

Page 46, starting with line 12, change the following paragraph as follows

The path splitting mirror 72 may be constructed so that the ratio between the amounts of light for transmission and reflection can be selected [more in] in more detail. Further, a stop for adjusting the amount of light is disposed in the optical path so that the supply of light to the plurality of light guide cables 63 can be controlled. Still further, if a beam re-forming optical system is interposed between the light guide cable 47 and the path splitting optical system to re-form the spread of a beam of light, a loss of the amount of light at the connecting optical system 70 can be compactly designed.

Page 46, starting with line 23, change the following paragraph as follows

As stated above, the light transmitter most suitable for transmitting the light over a long distance is used to construct the light guide cable 47, and further the use of the connecting optical system 70 makes it possible to supply the light to the plurality of light guide [cable] cables 63. In this way, the illumination system for endoscopes which is capable of accommodating [the] endoscopic surgery can be provided.

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